

Appln. S.N. 10/695,306
Amdt. dated November 4, 2005
Reply to Office Action of August 5, 2005
Docket No. 100204708-1

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In the claims:

1. (Currently amended) A method of making a patterned ceramic film, comprising:
depositing a liquid precursor solution onto a substrate, thereby forming a liquid film, the liquid precursor solution having at least one soluble inorganic metal salt dissolved into a photoresist;
 patterning the liquid film; and
heating the patterned liquid film, thereby producing the patterned ceramic film;
wherein the patterned ceramic film is adapted for use as at least one of ion-conducting ceramics, electrodes, hard ceramic coatings, transparent conducting oxides, transparent semiconducting oxides, ferroelectric oxides, and dielectric oxides.
2. (Currently amended) The method as defined in claim 1 wherein the at least one soluble inorganic metal salt includes a metal cation and a salt anion, and wherein the salt anion is selected from ~~comprises at least one of~~ nitrates, sulfates, chlorides, and mixtures thereof.
3. (Currently amended) The method as defined in claim 2 wherein the at least one soluble inorganic metal salt is selected from ~~at least one of~~ cerium nitrate, and samarium nitrate, and combinations thereof.
4. (Currently amended) The method as defined in claim 1 wherein the at least one soluble inorganic metal salt is substantially completely dissolved into the photoresist, and wherein the liquid precursor solution is substantially fully miscible.
5. (Original) The method as defined in claim 1 wherein at least one additive is mixed into the liquid precursor solution.

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6. (Currently amended) The method as defined in claim 5 wherein the at least one additive is selected from at least one of 2,5 dimethyl 2,5-di-t-butylperoxy hexane and alpha, alpha-dimethoxy-alpha-phenylacetophenone, and mixtures thereof.

7. (Currently amended) The method as defined in claim 1 wherein the photoresist is selected from at least one of diacrylates, polyvinylphenol (PVP), poly(4-vinylphenol), poly(4-hydroxystyrene), DNQ (diazonaphthoquinone)-Novolaks, and mixtures thereof.

8. (Original) The method as defined in claim 1 wherein the liquid film ranges in thickness between about 0.05 μm and about 0.5 μm .

9. (Original) The method as defined in claim 1 wherein the patterned ceramic film has a thickness ranging between about 0.2 μm and about 0.3 μm .

10. (Original) The method as defined in claim 1 wherein patterning comprises:
masking a predetermined portion of the liquid film, wherein the liquid film has a masked portion and an unmasked portion;
exposing the liquid film to a light source, whereby one of the masked portion and the unmasked portion is cured; and
removing the uncured portion.

11. (Original) The method as defined in claim 10, further comprising baking the exposed liquid film before removing the uncured portion.

12. (Original) The method as defined in claim 11 wherein the bake temperature ranges between about 50°C and about 250°C.

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13. (Original) The method as defined in claim 12 wherein the bake temperature is about 100°C.

14. (Original) The method as defined in claim 10 wherein the removing is accomplished by solvent stripping.

15. (Original) The method as defined in claim 14 wherein the removing is accomplished by dissolving the uncured portion of the liquid film in isopropyl alcohol.

16. (Original) The method as defined in claim 1 wherein heating is accomplished by firing the patterned liquid film.

17. (Original) The method as defined in claim 16 wherein firing temperatures range between about 540°C and about 1050°C.

18. (Original) The method as defined in claim 16 wherein firing temperatures range between about 550°C and about 600°C.

19. (Currently amended) The method as defined in claim 1 wherein the substrate is selected from at least one of silicon, single crystal silicon, polycrystalline silicon, silicon oxide containing dielectric substrates, alumina, sapphire, ceramic, and mixtures thereof.

20. (Currently amended) The method as defined in claim 1 wherein the depositing is accomplished by one of spin coating, screen printing, dip coating, meniscus coating, or and spray coating.

21. (Original) The method as defined in claim 1 wherein the patterned ceramic film has a line width, the line width ranging between about 0.5 μm to about 2 mm.

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22. (Original) A patterned ceramic film produced by the process of claim 1.
23. (Currently amended) A fuel cell, comprising:
at least one electrode operatively disposed in the fuel cell; and
an electrolyte in electrochemical contact with the at least one electrode; wherein
at least one of the electrode or the electrolyte comprises a patterned ceramic film
produced by the process comprising:
depositing a liquid precursor solution onto a substrate, thereby forming a
liquid film, the liquid precursor solution having at least one soluble inorganic
metal salt dissolved into a photoresist;
 patterning the liquid film; and
heating the patterned liquid film, thereby producing the patterned ceramic
film.
24. (Currently amended) The fuel cell as defined in claim 23 wherein the at least
one soluble inorganic metal salt is selected from at least one of cerium nitrate, and
samarium nitrate, and combinations thereof.
25. (Currently amended) The fuel cell as defined in claim 23 wherein the at least
one soluble inorganic metal salt is substantially completely dissolved into the
photoresist, and wherein the liquid precursor solution is substantially fully miscible.
26. (Original) The fuel cell as defined in claim 23 wherein at least one additive is
mixed into the liquid precursor before the liquid precursor is deposited on the substrate.
27. (Currently amended) The fuel cell as defined in claim 26 wherein the
additive is selected from at least one 2,5 dimethyl 2,5-di-t-butylperoxy hexane, and
alpha, alpha-dimethoxy-alpha-phenylacetophenone, and mixtures thereof.

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28. (Currently amended) The fuel cell as defined in claim 23 wherein the electrode is selected from at least one of an anode and a cathode.

29. (Original) The fuel cell as defined in claim 23 wherein the photoresist is tetraethylene glycol diacrylate.

30. (Original) The fuel cell as defined in claim 23 wherein the patterned ceramic film ranges in thickness between about 0.2 μm and about 0.3 μm .

31. (Original) The fuel cell as defined in claim 23 wherein the liquid film ranges in thickness between about 0.05 μm and about 0.5 μm .

32. (Original) The fuel cell as defined in claim 23 wherein patterning comprises:
masking a predetermined portion of the liquid film, wherein the liquid film has a masked portion and an unmasked portion;

exposing the liquid film to a light source, whereby one of the masked portion and the unmasked portion is cured; and
removing the uncured portion.

33. (Original) The fuel cell as defined in claim 32, further comprising baking the exposed liquid film before removing the uncured portion.

34. (Original) The fuel cell as defined in claim 33 wherein the bake temperature ranges between about 50°C and about 250°C.

35. (Original) The fuel cell as defined in claim 34 wherein the bake temperature is about 100°C.

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36. (Original) The fuel cell as defined in claim 32 wherein the removing is accomplished by solvent stripping.

37. (Original) The fuel cell as defined in claim 36 wherein the removing is accomplished by dissolving the uncured portion of the liquid film in isopropyl alcohol.

38. (Original) The fuel cell as defined in claim 23 wherein the heating is accomplished by firing the patterned liquid film.

39. (Original) The fuel cell as defined in claim 38 wherein firing temperatures range between about 540°C to about 1050°C.

40. (Currently amended) The fuel cell as defined in claim 23 wherein the substrate is selected from at least one of silicon, single crystal silicon, polycrystalline silicon, silicon oxide containing dielectric substrates, alumina, sapphire, ceramic, and mixtures thereof.

41. (Original) An electronic device, comprising:
a load; and
the fuel cell of claim 23 connected to the load.

42. (Currently amended) A method of using a patterned ceramic film, the patterned ceramic film having been formed by a process comprising:
depositing a liquid precursor solution onto a substrate, thereby forming a liquid film, the liquid precursor solution having at least one soluble inorganic metal salt dissolved into a photoresist;
patternning the liquid film; and
heating the patterned liquid film, thereby producing the patterned ceramic film;

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wherein the method of using the patterned ceramic film comprises operatively disposing the patterned ceramic film in a device, wherein the patterned ceramic film is comprises at least one of an ion-conducting ceramic, an electrode, a hard ceramic coating, a transparent conducting oxide, a transparent semiconducting oxide, a ferroelectric oxide, or and a dielectric oxide.

43. (Currently amended) A method of using a fuel cell, comprising:
operatively connecting the fuel cell to a load, wherein the fuel cell comprises at least one of an electrode or and an electrolyte comprising a patterned ceramic film formed by a process comprising:

depositing a liquid precursor solution onto a substrate, thereby forming a liquid film, the liquid precursor solution having at least one soluble inorganic metal salt dissolved into a photoresist;
 patterning the liquid film; and
 heating the patterned liquid film, thereby producing the patterned ceramic film.

44. (Currently amended) The method as defined in claim 43 wherein the electrode is selected from at least one of an anode and a cathode.

45. (Currently amended) A ceramic film, comprising:
an inorganic metal-organic liquid precursor solution having a pattern; and
means for converting the precursor solution into the ceramic film having the pattern therein, wherein the ceramic film is adapted for use as at least one of ion-conducting ceramics, electrodes, hard ceramic coatings, transparent conducting oxides, transparent semiconducting oxides, ferroelectric oxides, or and dielectric oxides.

46. (Currently amended) A method of making a patterned ceramic film, comprising:

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depositing a liquid precursor solution onto a substrate, thereby forming a liquid film, the liquid precursor solution having at least one soluble inorganic metal salt dissolved into a photoresist, wherein the at least one soluble inorganic metal salt is substantially completely dissolved into the photoresist, and wherein the liquid precursor solution is substantially fully miscible;

patterning the liquid film, wherein patterning comprises:

masking a predetermined portion of the liquid film, wherein the liquid film has a masked portion and an unmasked portion;

exposing the liquid film to a light source, whereby one of the masked portion and the unmasked portion is cured; and

removing the uncured portion; and

firing the patterned liquid film at a temperature sufficient to substantially drive off organic materials, thereby rendering the patterned ceramic film;

wherein the patterned ceramic film is adapted for use as at least one of ion-conducting ceramics, electrodes, hard ceramic coatings, transparent conducting oxides, transparent semiconducting oxides, ferroelectric oxides, or dielectric oxides.

47. (Currently amended) The method as defined in claim 46 wherein the at least one soluble inorganic metal salt is selected from at least one of cerium nitrate, and samarium nitrate, and combinations thereof.

48. (Original) The method as defined in claim 46 wherein the liquid film ranges in thickness between about 0.05 μm and about 0.5 μm .

49. (Original) The method as defined in claim 46 wherein the patterned ceramic film has a thickness ranging between about 0.2 μm and about 0.3 μm .

50. (Previously presented) The method as defined in claim 1 wherein the photoresist is not water-soluble.

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51. (Previously presented) A method of making a patterned ceramic film, comprising:

depositing a liquid precursor solution onto a substrate, thereby forming a liquid film, the liquid precursor solution having at least one soluble inorganic metal salt dissolved into a photoresist;

patterning the liquid film; and

heating the patterned liquid film, thereby producing the patterned ceramic film.

52. (Currently amended) The method as defined in claim 51 wherein the at least one soluble inorganic metal salt includes a metal cation and a salt anion, and wherein the salt anion is selected from ~~comprises at least one of~~ nitrates, sulfates, chlorides, and mixtures thereof.

53. (Previously presented) A liquid precursor solution, comprising:
a photoresist; and
at least one soluble inorganic metal salt dissolved in the photoresist;
wherein the liquid precursor solution is adapted to be converted into a ceramic film.

54. (Currently amended) The liquid precursor solution as defined in claim 53 wherein the at least one soluble inorganic metal salt includes a metal cation and a salt anion, and wherein the salt anion is selected from ~~comprises at least one of~~ nitrates, sulfates, chlorides, and mixtures thereof.

55. (Previously presented) The liquid precursor solution as defined in claim 53 wherein the photoresist is not water soluble.